

PCT

**NOTIFICATION OF ELECTION**  
 (PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

|   |   |
|---|---|
| Date of mailing (day/month/year)<br>14 February 2001 (14.02.01)       | Applicant's or agent's file reference<br>PV/38664/PCT     |
| International application No.<br>PCT/IB00/00786                       | Priority date (day/month/year)<br>14 June 1999 (14.06.99) |
| International filing date (day/month/year)<br>13 June 2000 (13.06.00) |   |
| Applicant<br>MARIOTTI, Marco et al                                    |   |

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

20 December 2000 (20.12.00)

in a notice effecting later election filed with the International Bureau on:

2. The election  was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

|   |                                   |
|---|-----------------------------------|
| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland | Authorized officer<br>Olivia TEFY |
| Facsimile No.: (41-22) 740.14.35  | Telephone No.: (41-22) 338.83.38  |

INT'L COOPERATION TREATY  
PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

|  |   |  |
|--|---|--|
| Applicant's or agent's file reference<br><b>PV/38664/PCT</b> | <b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. |  |
| International application No.<br><b>PCT/IB 00/00786</b>      | International filing date (day/month/year)<br><b>13/06/2000</b>   | (Earliest) Priority Date (day/month/year)<br><b>14/06/1999</b> |
| Applicant<br><b>TELEFONAKTIEBOLAGET LM ERICSSON</b>          |   |  |

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

contained in the international application in written form.

filed together with the international application in computer readable form.

furnished subsequently to this Authority in written form.

furnished subsequently to this Authority in computer readable form.

the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2.  Certain claims were found unsearchable (See Box I).

3.  Unity of Invention is lacking (see Box II).

4. With regard to the title,

the text is approved as submitted by the applicant.

the text has been established by this Authority to read as follows:

5. With regard to the abstract,

the text is approved as submitted by the applicant.

the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

as suggested by the applicant.

because the applicant failed to suggest a figure.

because this figure better characterizes the invention.

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None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/00/00786

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04L27/36

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
|----------|--|-----------------------|
| X        | WO 99 25104 A (ERICSSON TELEFON AB L M)<br>20 May 1999 (1999-05-20)<br>page 5, line 9 - line 15<br>page 7, line 16 -page 8, line 14<br>figures 5,6<br>---  | 1,2                   |
| A        | LEPAISANT J ET AL: "CODAGE EN MODULATION<br>DE PHASE DES EMETTEURS REGIONAUX A<br>MODULATION D'AMPLITUDE: APPLICATION AU<br>RADIO-GUIDAGE"<br>ONDE ELECTRIQUE,FR,EDITIONS CHIRON S.A.<br>PARIS,<br>vol. 60, no. 10, page 33-38 XP000762760<br>ISSN: 0030-2430<br>* section III.3. *<br>figure 9<br>--- | 3,4                   |
| X        | ---  | 1                     |

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## \* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

|   |  |
|---|--|
| Date of the actual completion of the international search | Date of mailing of the international search report |
| 21 July 2000  | 28/07/2000   |

## Name and mailing address of the ISA

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## Authorized officer

Langinieux, F

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/00/00786

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No. |
|----------|---|-----------------------|
| A        | US 4 217 467 A (KOBAYASHI KAZUO ET AL)<br>12 August 1980 (1980-08-12)<br>column 2, line 37 -column 3, line 20<br>column 6, line 1 - line 48<br>figures 4,6,8<br>---   | 1-4                   |
| A        | PATENT ABSTRACTS OF JAPAN<br>vol. 011, no. 023 (E-473),<br>22 January 1987 (1987-01-22)<br>& JP 61 193543 A (FUJITSU LTD),<br>28 August 1986 (1986-08-28)<br>abstract<br>---  | 1-4                   |
| A        | LUCYSZYN S ET AL: "MULTI-LEVEL DIGITAL<br>MODULATION PERFORMED DIRECTLY AT CARRIER<br>FREQUENCY"<br>PROCEEDINGS OF THE EUROPEAN MICROWAVE<br>CONFERENCE, GB, SWANLEY, NEXUS MEDIA,<br>vol. CONF. 25, page 673-676 XP000681807<br>ISBN: 1-899919-15-5<br>the whole document<br>----- | 1                     |

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/00/00786

| Patent document cited in search report |   | Publication date |  | Patent family member(s) |  | Publication date |
|--|---|------------------|--|-------------------------|--|------------------|
| WO 9925104                             | A | 20-05-1999       |  | US 6002923 A            |  | 14-12-1999       |
|  |   |                  |  | AU 1354999 A            |  | 31-05-1999       |
| US 4217467                             | A | 12-08-1980       |  | JP 975503 C             |  | 30-10-1979       |
|  |   |                  |  | JP 51120110 A           |  | 21-10-1976       |
|  |   |                  |  | JP 54007656 B           |  | 09-04-1979       |
|  |   |                  |  | JP 899404 C             |  | 25-02-1978       |
|  |   |                  |  | JP 51015914 A           |  | 07-02-1976       |
|  |   |                  |  | JP 52025683 B           |  | 09-07-1977       |
|  |   |                  |  | DE 2532287 A            |  | 12-02-1976       |
|  |   |                  |  | FR 2279278 A            |  | 13-02-1976       |
|  |   |                  |  | GB 1519972 A            |  | 02-08-1978       |
|  |   |                  |  | US 4166923 A            |  | 04-09-1979       |
| JP 61193543                            | A | 28-08-1986       |  | NONE                    |  |                  |

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

## (PCT Article 36 and Rule 70)

|   |  |   |
|---|--|---|
| Applicant's or agent's file reference<br><br>PV/38664/PCT   | <b>FOR FURTHER ACTION</b>                                    | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
| International application No.<br><br>PCT/IB00/00786   | International filing date (day/month/year)<br><br>13/06/2000 | Priority date (day/month/year)<br><br>14/06/1999  |
| International Patent Classification (IPC) or national classification and IPC<br><br>H04L27/36   |  |   |
| <p><b>Applicant</b><br/>TELEFONAKTIEBOLAGET LM ERICSSON</p>   |  |   |
| <p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 4 sheets.</p>  |  |   |
| <p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the report</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input type="checkbox"/> Certain defects in the international application</li> <li>VIII <input checked="" type="checkbox"/> Certain observations on the international application</li> </ul> |  |   |

|   |   |
|---|---|
| Date of submission of the demand<br><br>20/12/2000  | Date of completion of this report<br><br>16.08.2001                     |
| Name and mailing address of the international preliminary examining authority:<br><br> European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized officer<br><br>Cretaine, P<br>Telephone No. +49 89 2399 8828 |



# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/00786

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

### Description, pages:

3-6 as originally filed

1,2,2a as received on 26/07/2001 with letter of 26/07/2001

### Claims, No.:

1-3 as received on 26/07/2001 with letter of 26/07/2001

### Drawings, sheets:

1/2,2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/IB00/00786

the description,      pages:  
 the claims,      Nos.:      4  
 the drawings,      sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):  
*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. Statement

|                               |      |            |
|-------------------------------|------|------------|
| Novelty (N)                   | Yes: | Claims 1-3 |
|                               | No:  | Claims     |
| Inventive step (IS)           | Yes: | Claims 1-3 |
|                               | No:  | Claims     |
| Industrial applicability (IA) | Yes: | Claims 1-3 |
|                               | No:  | Claims     |

2. Citations and explanations  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

The invention relates to a method of phase and amplitude modulation of a RF carrier signal supplied to a power amplifier.

Prior art:

D1 = WO-A-99 25104 discloses a transmitter using QAM modulation with Direct Digital Synthesis and upconversion to achieve greater frequency coverage at the RF bands. The phase modulated analog output of a DDS signal generator is frequency multiplied and frequency upconverted, the resulting signal being combined with the amplitude modulated analog output of the DSS to generate the RF signal to be amplified.

Invention:

The aim of the invention is to minimize the output back-off of the power amplifier which is necessary for ensuring a linear function of the amplifier.

This is achieved, according to the features of claim 1, by first performing a phase modulation in baseband on portions of the input signal and further performing a RF amplitude modulation of the power amplifier output by using different portions of the same input signal.

By separately performing a phase modulation and a RF modulation on the final amplifier on different portions of the same input signal, a non-linear transmission chain is provided up to the amplifier. The required output back-off of the power amplifier is just the one allowing the RF amplitude modulation.

None of the cited documents cited in the International Search report teaches or suggests the combination of features of claim 1. In particular, the article of LEPAISANT (= D2) discloses multiplying a phase modulated signal by an amplitude modulated signal. Claim 1 therefore meets the requirement of Article 33 PCT.

Claims 2 and 3 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

**Re Item VIII**

**Certain observations on the international application**

1. The feature of claim 1, that the amplitude modulation is performed in an analogue manner, is not referred to in the description. On the contrary the description recites (see page 2, line 13; page 3, line 19) that the amplitude modulation is a digital one. Claim 1 is therefore not supported by the description as required by Article 6 PCT.
  
2. Dependent claim 3 relates to a method but contains system features. The category of the claim is thus unclear (PCT guidelines, III-3.1).

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PCT/IB00/00786

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**METHOD  
"EXCEVER OF DIGITAL PHASE AND AMPLITUDE MODULATION (PSK/ASK)"**

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**FIELD OF THE INVENTION**

This invention refers to a <sup>method</sup> system of phase and amplitude modulation (PSK/ASK), which allows a significant improvement of the spectral efficiency, with a small increase of the complexity of construction.

Namely, this <sup>method</sup> system provides a simple way to increase spectral efficiency (i.e. to increase bit rate with the same spectrum occupancy) with a minimum impact on transmitter complexity, allowing however a working point of the same very close to the saturation, and with small requirements on phase noise, with respect to the conventional linear RF transmitters, which utilise non-circular constellations of the type M-QASK.

**STATE OF ART AND RELATED PROBLEMS**

The linearity of the transmission chain - particularly in the last stage of said chain, which is the power amplifier (that should be allowed to work far enough from its saturation, i.e. to exhibit a sufficient output back-off to provide amplitude modulation) - and the stability of the RF oscillator are among the most severe requirements in medium-high capacity radio systems.

In a traditional system of quadrature amplitude modulation (QAM) or in a traditional system of amplitude and phase modulation (PSK/ASK) it is possible to achieve, by ensuring a very low RF distortion and a very low phase noise, to meet quality requirements (low bit error rate - BER) for the modern telecommunication networks. However, this causes design difficulties and, accordingly, high costs.

This invention aims at achieving the same results in a much more simple way, obtaining a high increase in the spectral efficiency, a high operation flexibility and a high reliability of the system performance. Since the invention

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requires a very small increase of system and hardware complexity, it also lowers the production costs.

SUMMARY OF THE INVENTION

&lt;A&gt;

~~With the above aims, this invention refers to a system of phase and amplitude modulation (PSK/ASK) of a single information flow, characterised in that a phase modulation in baseband and a RF frequency modulation are performed separately by using different portions of the same information flow as a modulating signal.~~

~~Preferably, a standard, digital phase modulation (PSK) is implemented in baseband in this system of modulation and the number of symbols or signals which form the constellation alphabet is increased by overlapping a digital amplitude modulation (ASK) which is synchronous with the bit flow, directly to a radiofrequency.~~

Advantageously,  $M$  discrete phase-shift levels in baseband and  $N$  discrete RF levels of amplitude can be used in the same ~~system~~ method.

The ~~system~~ of modulation according to the invention is effectively provided by means of a circuitry comprising in cascade a bit source, a digital phase modulator (PSK) in baseband and, in a single block, a voltage controlled oscillator, a multiplier and a power amplifier.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The invention is now described in greater detail below, referring to the figures in the annexed drawing, wherein:

Fig. 1 is a block diagram showing the circuitry to provide the ~~system~~ <sup>method</sup> of modulation according to the invention;

Fig. 2 shows an example of scheme or constellation, wherein the inventive ~~system~~ <sup>method</sup> of modulation is realised, in the case of four phase levels and two amplitude levels;

Fig. 3 shows another constellation, which is similar to the previous one in Fig. 2, but wherein an additional RF phase shift by  $90^\circ$  is introduced; and

- 2a -

<A>

The invention also differs from WO-99/25104, which teaches to perform separately a phase modulation in baseband and a RF amplitude modulation. In fact, according to the teaching of this document, when different portions of the same information flow are used as a modulating signal, the system operates in digital manner and this does not permit to minimize the output back off of the final power amplifier, as, on the contrary, the invention proposes to obtain.

#### SUMMARY OF THE INVENTION

With the aims considered above, this invention refers to a method of phase and amplitude modulation (PSK/ASK) of a RF carrier to be supplied before final transmission to a power amplifier, in which a phase modulation in baseband and a RF amplitude modulation are performed separately by using different portions of the same information flow as a modulating signal, characterised in that the amplitude modulation is performed in an analogue manner and in that the portion of the information flow carrying out the amplitude modulation directly controls the final power amplifier.

CLAIMS

- 1) Method of phase and amplitude modulation (PSK/ASK) of a RF carrier to be supplied before final transmission to a power amplifier, in which a phase modulation in baseband and a RF amplitude modulation are performed separately by using different portions of the same information flow as a modulating signal, characterised in that the amplitude modulation is performed in an analogue manner and in that the portion of the information flow carrying out the amplitude modulation directly controls the final power amplifier.
- 2) Method of modulation as claimed in claim 1, wherein M discrete phase-shift levels in baseband and N discrete RF levels of amplitude can be used in the same method.
- 3) Method of modulation as claimed in claims 1 and 2, which is provided by means of a circuitry comprising in cascade a bit source (1), a digital phase modulator (PSK) (2) in baseband and, in a single block, a voltage controlled oscillator (3), a multiplier (4) and a power amplifier (5).